Tri-Service Assessment Initiative Phase 2 Systemic Analysis Results

Conference on the Acquisition of Software Intensive Systems
## *January 28, 2003*

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Presentation Objectives

- *Convey what we have learned through a systemic "Cross Program" analysis of multiple DoD software intensive programs*

- *Describe and quantify the recurring issues that impact DoD software intensive program performance*

- *Characterize the identified DoD program performance issues in terms of cause and effect*

- *Initiate discussion on potential corrective action strategies*

Phase 2 Overarching Conclusion

*The analysis predicts an increasing gap between what is expected and what is capable of being achieved*
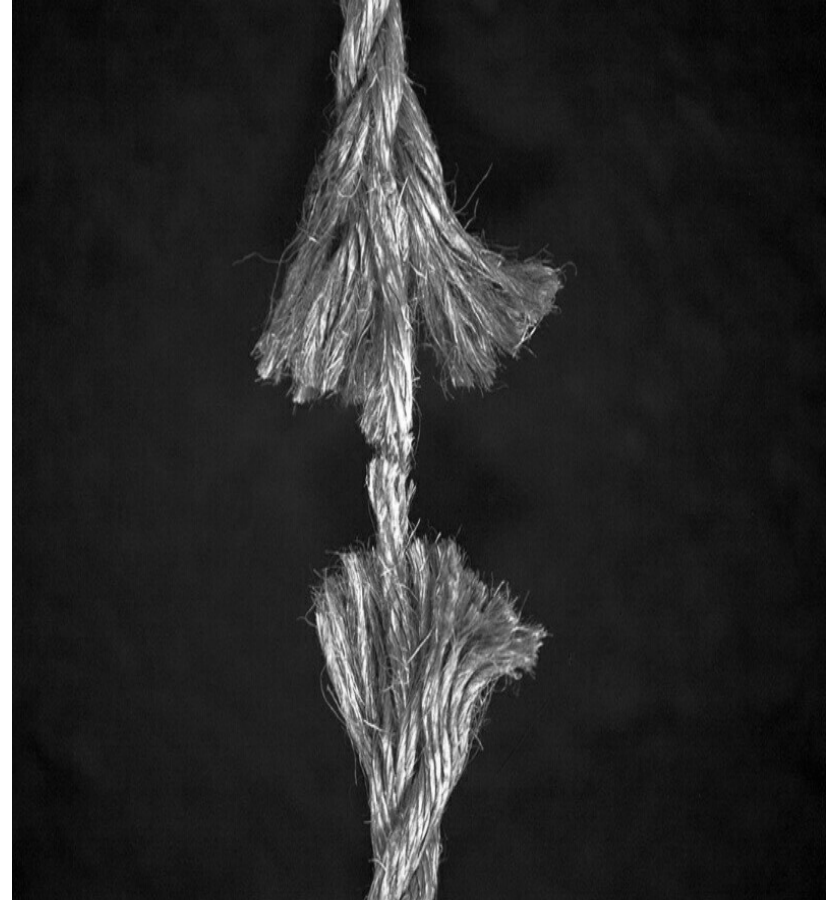
Summary Findings

- *Software intensive system development issues are still pervasive across DoD programs*

- *New emerging issues reflect complex, risk-prone acquisition trends. These include:*
    - *interoperability / family of systems*
    - *co-dependent systems development*
    - *"mission resilient", evolutionary system development*
    - *direct funding - Congressional plus-ups*
    - *expanded contractor acquisition and program management responsibilities*
    - *acquisition policy easements*

What You Need to Know

- *The causes of program performance shortfalls are extremely complex - improvement strategies and associated action plans must address this complexity*

- *As an Enterprise we need to start by re-addressing the performance issues we thought we were already fixing*

- *The longer we wait - the higher the risk*

Tri Service Assessment Initiative

Tri-Service Assessment Activities

Individual Program Assessments

Systemic Analysis
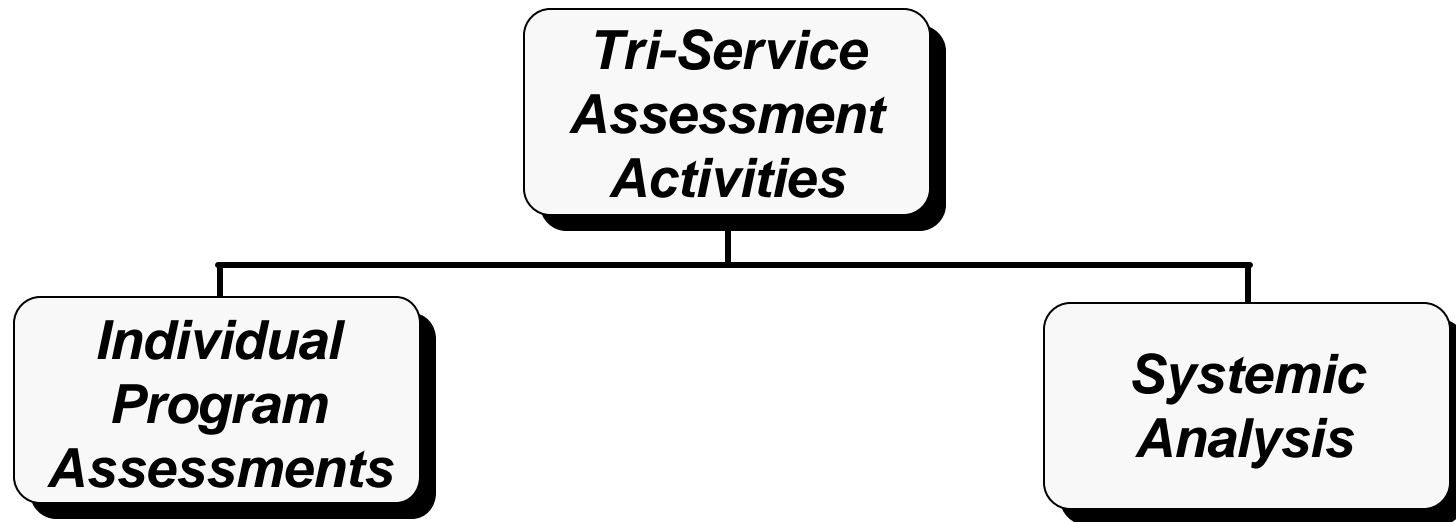
- *Independent Expert Program Reviews*
- *Single Program Focus*
- *Objective - Improve Program Performance*
- *Program Team Insight*

- *Cross-Program Analysis*
- *Enterprise Focus*
- *Objective - Identify and Characterize Recurring Performance Issues*
- *General and Directed Analyses*
- *Enterprise Manager Insight*

Both Activities are Based on an Integrated Assessment Architecture

Systemic Analysis Phases

Phase 1 - Complete July 2001

- *Top down analysis approach*
- *Initial models - proof of concepts*
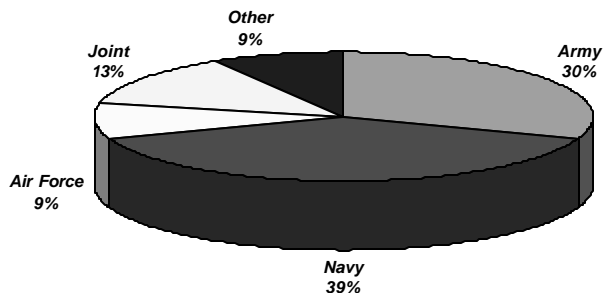- *Assessment architecture integration*
- *Initial data set - 10 assessments*

Phase 2 - Complete December 2002

- *Bottom up analysis approach*
- *Based on quantification of recurring issues and sequences*
- *Information driven analysis objectives*
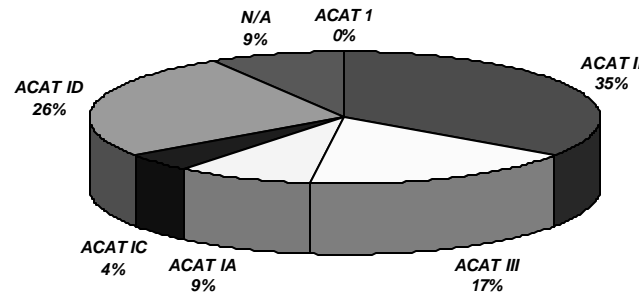- *Systemic database*
- *Extended data set - 23 assessments*

Phase 3 - Began January 2003

- *Predictive issue pattern analysis*
- *Quantification of projected issue impacts*
- *Architecture and analysis process improvements*
- *Comprehensive transition program*

Assessment Distribution

**Distribution of Assessments
by Service**

Other
9%

Joint
13%

Army
30%

Air Force
9%

Navy
39%

**Distribution of Assessments
by ACAT Level**

N/A
9%

ACAT 1
0%

ACAT II
35%

ACAT ID
26%

ACAT IC
4%

ACAT IA
9%

ACAT III
17%
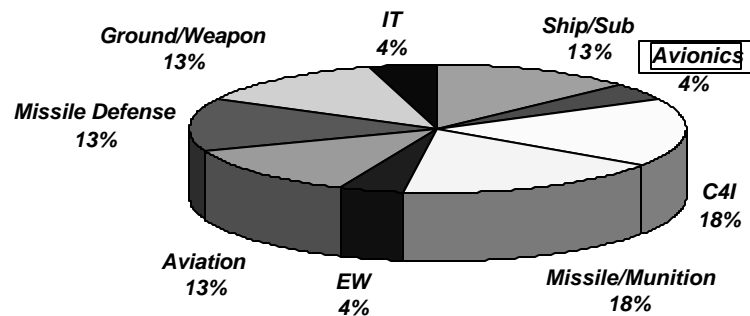
**Distribution of Assessments
by Domain**

Ground/Weapon
13%

IT
4%

Ship/Sub
13%

Avionics
4%

Missile Defense
13%

C4I
18%

Aviation
13%

EW
4%

Missile/Munition
18%

Systemic Analysis Process

Program Assessment Results

Analyze Assessment Findings

- *Systemic Peer Review*
- *Assessment Characterization*
- *Issue Identification*
- *Risk Typology Allocations*
- *Initial Cause and Effect Model*

Basic Analysis

- *Issue Frequency of Occurrence Analysis - Data Normalization*
- *Enterprise - Program Issue Responsibility Allocations*
- *Definition of Information Needs*
- *Issue Concurrency Analysis*
- *Issue Sequence Identification and Analysis - Interaction*
- *Issue Characterization - Triggers / Symptoms*

Directed Analysis

- *Executive Data Call*
- *Basic Analysis Review*
- *Definition - Prioritization of Information Needs*
- *Individual Case Analysis*

Integrated Analysis

- *Issue Correlation*
- *Risk Analysis*
- *External Correlations*
- *Systemic Analysis Model*
- *Executive Level Conclusions / Summary*

Action Plan

What Was Counted

- *Identified Issues*
  - *single issues*
  - *composite issues*
  - *component issues*
- *Systemic Sequences*
- *Systemic Patterns*
- *Triggers and Symptoms*

Identified Issue

Single Issue   **Composite Issue**

Component Issue   **Component Issue**

Issue Structure

Trigger Issue
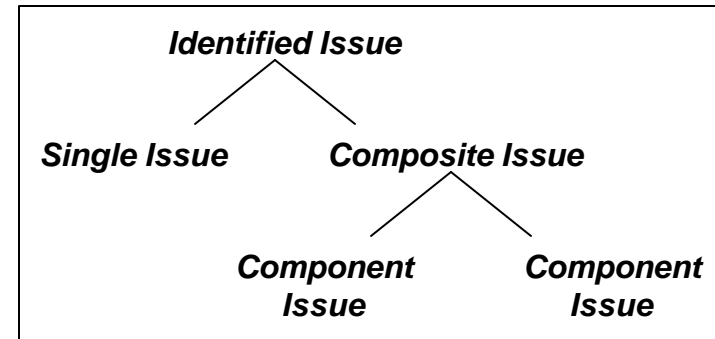
Systemic Issue

Symptom Issue
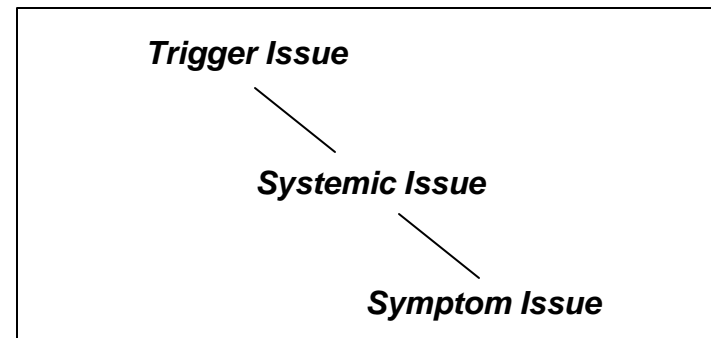
Systemic Issue Pattern

Basic Analysis

Critical program performance problems

Identified Issues	Relative Occurrence
Process Capability	91 %
Organizational Management	87 %
Requirements Management	87 %
Product Testing	83 %
Program Planning	74 %
Product Quality - Rework	70 %
System Engineering	61 %
Process Compliance	52 %
Program Schedule	48 %
Interoperability	43 %
Decision Making	43 %
...	
Configuration Management	26%

Basic Analysis

Complex issues with multiple interactions across all levels of DoD management

Identified Issues by Responsibility
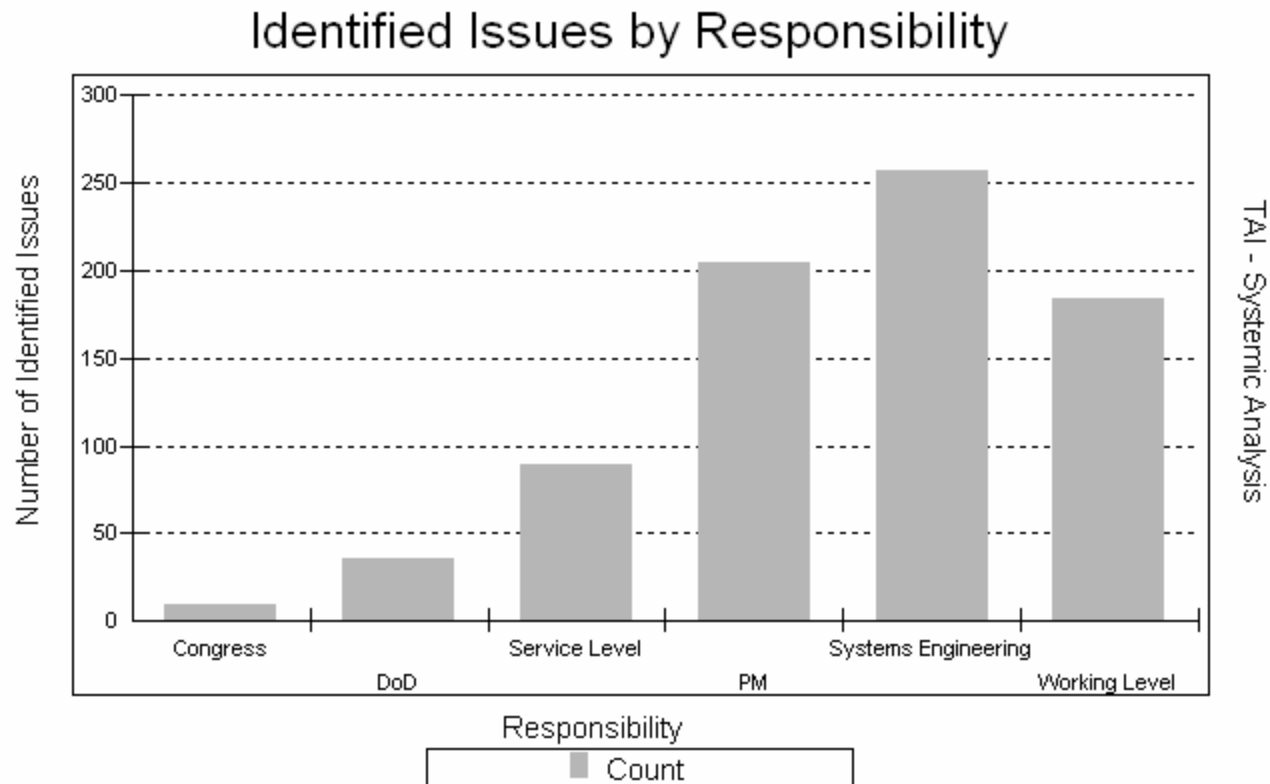
Issue Migration

Sequence Starts - Start Responsibility by Next Responsibility
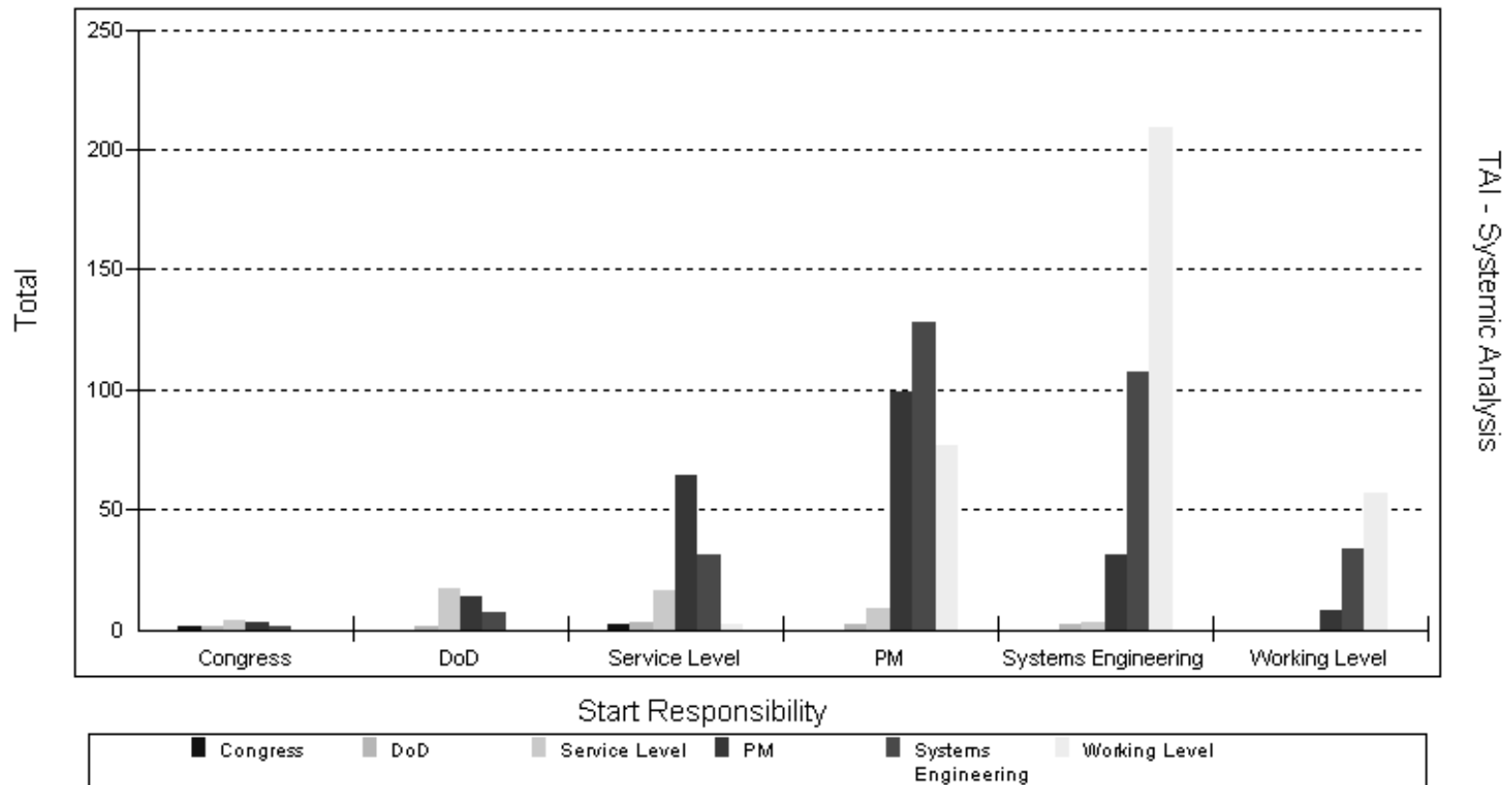
Basic Analysis

The primary <u>causative</u> performance issues are:

- *Process capability shortfalls: the inability of the program team to design, integrate, and implement processes that adequately support the needs of the program*

- *Requirements development and management shortfalls*

- *Organizational management and communication limitations*

- *Stakeholder agendas and related program changes*

- *Product architecture deficiencies*

Cause and Effect Impacts

- *<u>Process Capability</u> problems result in:*
  - *- Inadequate Testing*
  - *- Poor Change Management*
  - *- Poor Product Quality*
  - *- Progress Shortfalls*

- *<u>Requirements Management</u> problems result in:*
  - *- Poor Product Quality*
  - *- Product Rework*
  - *- Progress Shortfalls*

- *<u>Organizational and Program Management</u> problems result in:*
  - *- Inadequate Program Planning*
  - *- Responsibility Conflicts*
  - *- Poor Communications*
  - *- Product Rework*
  - *- Progress Shortfalls*

Basic Analysis

Under pressure, Program Managers make trade-off decisions that impact, in order:

- *Development progress*
- *Product technical performance*
- *Product quality and rework*
- *System usability*
- *Cost*

Basic Analysis Summary

- *The current DoD program issue profile shows little positive impact from past corrective actions, initiatives, and policy*

- *The Program Manager and the Development Team must address the majority of the program issues, even if they are caused by enterprise level decisions or behaviors*

- *Causative issues multiply downstream*

- *The Program Team creates many of their own performance problems*

- *There are no "single issue" program performance drivers*

Directed Analysis

- *Software Engineering Process*

- *Systems Engineering*

- *Software Testing*

- *Program Organization and Communication*

Software Engineering Process

Analysis Results

- 91% of the assessments had process capability issues (75% triggers)
- 52% of the assessments had process compliance issues (63% triggers)
- Predominant deficiencies: requirements, risk / measurement, testing, systems engineering, change management

Implications

- The performance problem extends beyond developer software process compliance
- False assumption that organizational process compliance equates to required program process capability
- Compliant organizations still have significant performance shortfalls
- Key process concerns:
    - a. focus is too narrow in scope
    - b. impacts of program constraints
    - c. large program team process incompatibilities
    - d. program teams just not good enough

Systems Engineering

Analysis Results

- 61% of the assessments had systems engineering issues (23% triggers)
- 11 of the 16 programs that have requirements issues have SE issues
- 43% of the assessments have interoperability issues (50% triggers)
- Predominant deficiencies: Non-existent SE, lack of SE expertise, poor SE implementation, dispersion of SE responsibility and authority, existing SE inadequate for program requirements

Implications

- Cost overruns, schedule slips and rework will continue to plague programs
- The most technically complex systems have the most systems engineering issues
- Interoperability of systems is in doubt
- Rapid exploitation of new/innovative technology is difficult

Systems Engineering Findings

- *DoD programs have significant shortfalls with respect to systems engineering yet this is where most of the identified program issues exist*

- *"Systems engineering by committee" is both common and ineffective*

- *Programs continuously face unfunded and unplanned mandates related to family of systems management and interoperability*

- *Trade off decisions are often extremely constrained*

> **Systems engineering must take a primary and renewed role in today's DoD programs**

Software Testing

Analysis Results
- *83% of the assessments had testing related issues (53% triggers)*
- *Predominant deficiencies: lack of test time, facilities, testing cutbacks, poor test procedures*
- *73% of the programs with schedule problems had testing issues*
- *80% of the programs with requirements problems had testing issues*

Implications
- *Overarching testing risk - late discovery of defects (94%)*
- *Most testing issues result in quality shortfalls and rework*
- *Testing of complex systems is an emerging concern*
- *Primary causes of testing shortfalls:*
    - *a. requirements (71%)*
    - *b. test facilities (71%)*
    - *c. test process capability (65%)*
    - *d. schedule constraints (41%)*

Program Organization and Communication

Analysis Results

- *87% of the assessments had communications issues (65% triggers)*
- *Every program with IPT related issues had communications issues*
- *Predominant deficiencies: unclear roles and responsibilities, delayed decision making, conflicting decisions, proprietary information (all exacerbated by widely dispersed organizational teams and complex organizational structures not suited for traditional management approaches)*

Implications

- *IPTs appear to create more management issues than they resolve*
- *Poor implementation of IPTs: proliferation, structure, membership, authority and decision responsibility issues*

Systemic Analysis Model

ENTERPRISE LEVEL

Congress	DoD	Service

PROGRAM LEVEL

Program Manager	Systems Engineering	Working Level

Program Decision Space

Acquisition Requirements
- Process
- Politics
- Strategy
- Assumptions

Policy Culture

Expectations
- Cost
- Schedule
- Performance
- Quality

Constraints
- Funding
- Resources
- Time
- Capability

Mission Allocation

Program Portfolio Management

Implementation Issues
- Complexity
- Capability
- Planning
- Program Trades
- Resource Allocation
- Management
- Organization
- Interoperability
- Conformance
- Leadership

Implementation Issues
- Process
- Product
- Information
- Capability
- Performance

ACQUISITION ENVIRONMENT
(Threats, Economy, Technology)

New Solution Strategy Required?

- *Past DoD acquisition solutions (strategies, policies, and initiatives) have had only limited success in reversing poor performance trends:*
    - *Single point solutions*
    - *Poorly evaluated*
    - *Focused on symptoms not causes*
    - *Lacking in implementation guidance*
    - *Conflicting*
    - *Volatile*
    - *Lack insight into solution effectiveness*
    - *Long lasting impacts and residuals*

Key Considerations

- *Need to establish performance parameters that can be implemented with success across the life of the program*
  - *Feasible plan*
  - *Understood constraints*
  - *Change tolerance*

- *Need to improve the capabilities of the development teams*
  - *Real systems engineering*
  - *Funded management and technical approaches critical to interoperability*
  - *Foundational processes*

Key Considerations

- *Need to ensure that all program stakeholders agree on an integrated strategy for attacking the high priority overarching program issues*
    - *Congress and enterprise*
    - *Program team*
    - *Education and technology infrastructures*

- *Need to augment recent acquisition policy changes with*
    - *A clear understanding of the complex interactions and constraints that programs are faced with*
    - *Adequate implementation guidance*
    - *Directed education*

Assessment & Analysis Essentials

- *Focus on performance improvement*
- *Enterprise performance is a composite of project performance*
- *Use a common architecture for project and systemic evaluation*
- *Address a wide scope of issues and issue sources*
- *Risk management and measurement processes are critical*
- *Flexibility is important – typology not taxonomy*
- *Relate subjective and quantitative information*
- *Information needs drive the analysis process*
- *Frequency of occurrence counts are just the first step*
- *Data integrity – data integrity – data integrity*
- *Consistent terminology*

Tri-Service Assessment Initiative™

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